A new chapter for MARPOL Annex VI – requirements for technical and operational measures to improve the energy efficiency of international shipping

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New regulations aimed at improving the energy efficiency of international shipping entered into force on 1 January 2013.

The amendments to the International Convention for the Prevention of Pollution from Ships (MARPOL) were adopted in July 2011.They add a new chapter 4 Regulations on energy efficiency for ships to MARPOL Annex VI, to make mandatory the Energy Efficiency Design Index (EEDI), for new ships, and the Ship Energy Efficiency Management Plan (SEEMP) for all ships. Other amendments to Annex VI add new definitions and the requirements for survey and certification, including the format for the International Energy Efficiency Certificate.

The regulations apply to all ships of 400 gross tonnage and above. However, under regulation 19, the Administration may waive the requirements for new ships up to a maximum of 4 years.

The EEDI is a non-prescriptive, performance-based mechanism that leaves the choice of technologies to use in a specific ship design to the industry. As long as the required energy-efficiency level is attained (regulations 20 and 21), ship designers and builders would be free to use the most cost-efficient solutions for the ship to comply with the regulations.

The SEEMP establishes a mechanism for operators to improve the energy efficiency of ships. Regulation 22 requires ships to keep on board a ship specific Ship Energy Efficiency Management Plan (SEEMP).

Enhancing energy efficiency

Shipping is permanently engaged in efforts to optimize fuel consumption. And, while ships are universally recognized as the most fuel-efficient mode of bulk cargo transportation, the Second IMO GHG Study, published in 2009, identified a significant potential for further improvements in energy efficiency, mainly through the use of already existing technologies such as more efficient engines and propulsion systems, improved hull designs and larger ships: or, in other words, through technical- and design-based measures that can achieve noteworthy reductions in fuel consumption and resulting CO_2 emissions on a capacity basis

(tonne-mile). The study also concluded that additional reductions could be obtained through operational measures such as lower speed, voyage optimization, etc.

The EEDI addresses the former type of measure by requiring a minimum energy efficiency level for new ships; by stimulating continued technical development of all the components influencing the fuel efficiency of a ship; and by separating the technical and design-based measures from the operational and commercial ones.

The SEEMP provides a management framework, that may form part of the ship's safety management system, for improving the energy efficiency of a ship whilst operating at sea and in port,.

Applicability

The EEDI formula – as presently drafted – is not supposed to be applicable to all new ships of 400 gross tonnes and above engaged in international trade. Indeed, it is explicitly recognized that it is not suitable for all ship types (particularly those not designed to transport cargo) or for all types of propulsion systems (e.g., ships with diesel-electric, turbine or hybrid propulsion systems will need additional correction factors).

Indeed, the first iteration of the EEDI has been purposefully developed for the largest and most energy-intensive segments of the world merchant fleet, thus embracing approximately 70 per cent of emissions from new ships and covering the following ship types: tankers, gas carriers, bulk carriers, general cargo ships, refrigerated cargo carriers and container ships.

For ship types not covered by the current formula, suitable formulae will be developed in due course to address the largest emitters first. IMO's Marine Environment Protection Committee (MEPC) is poised to consider the matter in detail at future sessions, with a view to adopting further iterations of the EEDI.

All existing ships of 400 gross tonnes and above engaged in international trade are required to implement and maintain a SEEMP which establishes a mechanism for operators to improve the energy efficiency of ships. This should be achieved by monitoring the energy efficiency performance of a ship's transportation work and at regular intervals considering new technologies and practices to improve energy efficiency.

The SEEMP will offer operators of existing ships the chance to reduce costs immediately by saving fuel. As the regulation does not set any energy efficiency requirements it will be up to the industry to proactively utilize SEEMP to ensure they optimize the fuel saving benefits. In the end it is in the industry's best interests to utilize the SEEMP as with fuel accounting for

over 50% of operational costs, keeping fuel costs in check is a major factor in the industry's economic health. Such an approach will be important to achieving both sustainable development and economic goals for the industry going forward.

A set of such guidelines was adopted by MEPC 63 (March 2012) intended to assist in the implementation of the mandatory regulations on Energy Efficiency for Ships in MARPOL Annex VI:

- resolution MEPC.212(93) – 2012 Guidelines on the method of calculation of the attained Energy Efficiency Design Index (EEDI) for new ships;
- resolution MEPC.213(93) – 2012 Guidelines for the development of a Ship Energy Efficiency Management Plan (SEEMP);
- resolution MEPC.214(93) – 2012 Guidelines on survey and certification of the Energy Efficiency Design Index (EEDI); and
- resolution MEPC.215(93) – Guidelines for calculation of reference lines for use with the Energy Efficiency Design Index (EEDI).

Minimum propulsion power

The need for a minimum propulsion power to be incorporated into the EEDI formula has been duly acknowledged and, to that end, regulation 21.5 of MARPOL Annex VI states that "For each ship to which this regulation applies, the installed propulsion power shall not be less than the propulsion power needed to maintain the manoeuvrability of the ship under adverse conditions as defined in the guidelines to be developed by the Organization."

It should, therefore, be clear that IMO fully supports the view that a minimum installed power to maintain safe navigation in adverse (weather) conditions is of critical importance to ensure both the safety and efficiency of international shipping. While the EEDI instrument therefore contains the standard to be achieved on this matter, implementation of that standard will be enabled through guidelines that are also to be adopted. IMO circular MSC-MEPC.2/Circ.11 provides "Interim Guidelines for determining minimum propulsion power to maintain the manoeuvrability of ships in adverse conditions".

Fuel efficiency and engine power

Although the easiest way to improve a vessel's fuel efficiency is, indeed, to reduce speed – hence the move to slow steaming by a significant number of ships – there is a practical minimum at which fuel efficiency will decrease as a vessel is slowed down further. There are other technical ways to improve fuel efficiency, such as waste heat generators, which do not impact on speed (they impact on auxiliary engines). Indeed, improvements in road transport efficiency have been made through advances in technology that have, however, not led to a sacrifice in speed; rather, quite the opposite.

It has been (wrongly) argued that the EEDI limits installed power and so induces owners to use small-bore high-rpm engines, thereby increasing fuel consumption. However, a reduction of installed power does not require a reduction in engine bore and increasing rpm. The easiest way to reduce power would be to “de-rate” the exact same engine by limiting the “maximum” rpm (remember, horsepower = torque multiplied by rpm). This would have the impact of increasing propeller efficiency (if the exact same propeller is installed), as propeller efficiency will generally improve as rpm decreases. Another practical way to reduce installed horsepower is to install an engine with one cylinder fewer. This would have no impact on specific fuel consumption or rpm. Such engines can be identified by reference to the catalogues of major engine manufacturers.

Of course, there are “economies of scale” in ships’ fuel efficiency. The larger the ship (at a given speed), the lower the fuel consumption per unit of cargo. However, such economies of scale are limited by trade considerations, physical port limitations (generally, draft) or cargo logistics issues. Therefore, ships tend to be designed to be as large as practical for a given trade.

Effectiveness of EEDI and SEEMP in reducing emissions from ships

The EEDI, in establishing a minimum energy efficiency requirement for new ships depending on ship type and size, provides a robust mechanism that may be used to increase the energy efficiency of ships, stepwise, to keep pace with technical developments for many decades to come. It is a non-prescriptive mechanism that leaves the choice of which technologies to use in a ship design to the stakeholders, as long as the required energy-efficiency level is attained, enabling the most cost-efficient solutions to be used. Such technologies have been comprehensively considered in the 2009 IMO GHG Study and are now frequently highlighted by the shipping media. A consequence of the new regulations, and the growing interest and demand for innovative energy efficiency improving technologies, is leading to significant investment in research and development.

Fuel oil consumption represents a significant element of the cost of operating a ship today. The effective implementation of SEEMP onboard a ship could lead to a reduction in fuel used, and so could be considered a commercial imperative, as much as a regulatory one, for those seeking to manage a ship in today’s market. To enable the ship’s energy efficiency performance is be optimised the operational energy efficiency measures employed either at sea or in port need to be robustly monitored and appropriate benchmarking tools used. Comparing the energy efficiency performance of one ship with that of a similar ship on the same trading route is also possible but this is more complicated as energy efficiency of different ships can be affected by many variables, not least, the weather and sea conditions they each experience. A proactive approach to energy management of a ship should deliver

cost improvements for the business and a reduction of emissions from ships for wider society.